STATE OF CALIFORNIA §

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COUNTY OF ALAMEDA §

AFFIDAVIT

On this day, Mark Robert Tompkins appeared before me, the undersigned notary public, and after I administered an oath to him, upon his oath, he said:

"My name is Mark Robert Tompkins. I am over 18 years of age, of sound mind, and am competent in all respects to make this affidavit. I have never been convicted of a felony or misdemeanor involving moral turpitude. Everything contained herein is based upon my own personal knowledge and is true and correct."

I hold B.S. and M.S. degrees in Civil and Environmental engineering from the University of Illinois, Urbana-Champaign, and a Ph.D. in Environmental Planning from the University of California, Berkeley. All of my academic work focused on river management, specifically in the areas of hydrology, hydraulics, sediment transport, flood management, and ecosystem restoration. I am a registered professional civil engineer in the States of California and Washington. I have over twenty years of professional consulting experience working on rivers throughout the United States. I have worked extensively on design and evaluation of the impacts of proposed structures in and along river corridors and floodways, and I have directly observed the site and initial stages of construction of Fisher Industries' private bollard fence.

This affidavit updates and expands upon the analyses and findings I testified to in my December 2, 2019 affidavit, and in my hearing testimony on January 3, 2020 (in person) and January 9, 2020 (telephonically). In addition to the materials I referenced in that affidavit and in my hearing testimony, I have reviewed hundreds of additional ground photographs of Fisher Industries' private bollard fence (during construction, at completion, and after multiple instances of erosion and scour damage during the summer of 2020), inspection survey measurements of erosion and scour damage along the fence during the summer of 2020, an International Boundary and Water Commission (IBWC) Technical Memorandum titled Mission Texas

Bollard Fence Hydraulic Analysis dated March 2020, an IBWC exhibit titled Problematic Deflections Fisher Fence Overview, email correspondence between March 2020 and May 2020 discussing Fisher Industries' attempts to complete analyses required by IBWC, a Fisher Industries document titled Operation and Maintenance Plan, US Geological Survey geologic maps characterizing conditions at the site of the Fisher Industries' private bollard fence, Fisher Industries' most recent 2D HEC-RAS hydraulic models labelled "Jan 31 2D Improved" and "Jan 31 2D Original" (provided by Fisher Industries in August 2020), and ground photographs of new rock material being placed on the river side of the fence in August 2020.

Based on the performance of the completed fence to date, and the completely inadequate analysis and documentation presented in the reference materials identified above, I find, with a reasonable degree of scientific certainty, the following:

1. Fisher Industries' private bollard fence caused substantial new erosion and scour along three miles of the Rio Grande during a low flow event.
2. Fisher Industries' private bollard fence will continue to exacerbate erosion and scour on the Rio Grande that will damage National Butterfly Center property.
3. Fisher Industries' private bollard fence will fail during extreme high flow events and further exacerbate damage at the failure site(s) and to adjacent lands, including the National Butterfly Center.
4. Fisher Industries' maintenance plan for their private bollard fence is not based on sound principles for effective bank stabilization and will not prevent future erosion and scour damage.
5. Fisher Industries most recent hydraulic model is flawed, and even if it conformed to professional engineering standards for the development of hydraulic models, it is not capable of assessing the impacts of Fisher Industries' private bollard fence on adjacent areas, including National Butterfly Center lands.

I elaborate on each of these five findings below.

1. *Fisher Industries' private bollard fence caused substantial new erosion and scour along three miles of the Rio Grande during a low flow event.*

The design flow in the Rio Grande River used in the design of Fisher Industries' private bollard fence is 235,000 cubic feet per second (cfs). After a modest peak flow of approximately 13,500 cfs, or 5.7% of the design flow, the river bank between the private bollard fence and the Rio Grande suffered extensive scour and erosion damage. Photos and observations made along the bollard fence after this period of low flows

clearly show river bank erosion and scour greatly exceeding erosion and scour in areas not immediately adjacent to the fence. Fisher Industries attempted to quickly repair this damage, after which a similar modest flow caused additional erosion and scour damage of a similar magnitude.

2. *Fisher Industries' private bollard fence will continue to exacerbate erosion and scour on the Rio Grande that will damage National Butterfly Center property.*

My previous analyses and testimony on this matter considered much higher flows than have occurred since Fisher Industries' private bollard fence was completed. It is now clear that the erosion and scour damage I predicted occurs at very low flows, and will be much greater during extreme high flows. In order to adequately assess the impacts of any structure on surrounding lands one must carefully consider fluvial geomorphology, that is the long-term (100 years or more) evolution of river channel, banks, and floodplain as it adjusts to altered physical conditions. Fisher Industries' three mile long private bollard fence is an extremely large change to the physical conditions in the Rio Grande floodway, and the major changes already observed and documented after modest flows that will occur almost every year demonstrate that the fence will change the Rio Grande as the river adjusts to the presence of the extensive new impediment to flow, sediment, and debris conveyed by the Rio Grande.

River bank erosion and bed scour is caused by shear stress imparted by the flowing water and is proportional to flow depth. The design flow elevation for the bollard fence is approximately 123 feet (approximate river depth of 19 feet), and that the maximum flow elevation since the bollard fence was completed was approximately 108 feet (approximate river depth of 4 feet). The 15 foot, or 375%, increase in depth the bollard fence will experience during the design flow will increase shear stresses by 375%. Further, as discussed above, one must account for numerous high flow events to adequately assess the long term impacts of massive structures like Fisher Industries' private bollard fence on surrounding lands in highly erodible river corridors like the Rio Grande. The river must adjust, as it has already during low flows, and I expect with a high degree of scientific certainty that continued adjustment, especially adjustment that occurs during extreme high flows, will damage National Butterfly Center lands immediately upstream of the fence.

3. *Fisher Industries' private bollard fence will fail during extreme high flow events and further exacerbate damage at the failure site(s) and to adjacent lands, including the National Butterfly Center.*

I define failure of a structure like Fisher Industries' private bollard fence as any significant departure from the as-built conditions assumed in analyses and design documents for the structure. The performance of

Fisher Industries' private bollard fence described above indicates that the fence will fail when exposed to the extreme hydraulic, sediment, and debris conditions expected during extreme flow events up to and including the design flow. In fact, based on my understanding of the foundation depth of the fence and photographs of erosion and scour undermining that foundation, the private bollard fence has already failed. That is, the fence caused unnatural erosion and scour that created topographic conditions along the fence that were not assumed or addressed in design analyses or documents.

Ongoing failures of Fisher Industries' private bollard fence will be extremely problematic, not only for the fence itself, but for adjacent lands upstream, downstream, and across from the fence. Discontinuities, that is abrupt changes in the topography, vegetation, or other aspects of a river corridor, typically result in concentration of hydraulic forces that increase the extent and rate of erosion and scour, especially in highly erodible rivers like the Rio Grande. When extreme flow events, laden with sediment and debris, completely undermine the foundation of the fence and create a flow path under the fence or cause a segment of the fence to topple into the river, unpredictable and damaging hydraulics will occur at the failure site(s). The unpredictable hydraulics at future failure site(s) will exacerbate damage to adjacent lands caused by the intact fence by locally increasing the rate and severity of damaging erosion and scour, thereby increasing impacts to adjacent lands as the river rapidly adjusts.

4. *Fisher Industries' maintenance plan for their private bollard fence is not based on sound principles for effective bank stabilization and will not prevent future erosion and scour damage.*

Maintaining infrastructure in an active floodway is complex and must be carefully planned and executed in order to be effective. I have prepared and reviewed maintenance plans for much smaller construction projects than Fisher Industries' private bollard fence in smaller and more stable rivers than the Rio Grande. All of these plans were vastly more detailed and much more rigorously supported by the voluminous guidance available from agencies responsible for maintaining safe river corridors than Fisher Industries' plan. Fisher Industries' maintenance plan for the private bollard fence, prepared after the fence was already built, is completely inadequate for a multimillion dollar, three mile long piece of infrastructure in a major floodway. Fisher Industries' plan refers to "caving and constantly migrating banks" on the Rio Grande, and posits that this is caused by conditions along the river in areas not cleared and altered by their private bollard fence. Yet, as described above, erosion and scour damage occurred all along their fence after modest flows, while areas not along their fence were relatively stable. Fisher Industries' plan also acknowledges that "debris found on the project" will cause problems and have to be addressed. The plan does not give any indication of how debris will be handled during the weeks or months when extreme high flows make it impossible to safely conduct maintenance work along the fence. Even more concerning, Fisher Industries'

plan notes they will only maintain "debris within our control." It is unclear what Fisher Industries means by this statement, but nearly all of the debris that will get impinged on the fence will come from sources out of Fisher's control.

The Fisher Industries' maintenance plan also has what I consider a fatal flaw. The plan asserts that "Once the vegetative cover is fully established as previously described the erosion protection measures will be fully effective." If Fisher is able to achieve fully established vegetative cover, they will have created a condition that virtually guarantees that their assumption of a maximum 30% flow blockage from their private bollard fence will be invalidated as vegetation immediately adjacent to the fence is mobilized and impinged on their fence.

In late August of 2020, Fisher Industries already departed from the approach described in their July 6 maintenance plan by placing non-engineered rock fill on the banks of the Rio Grande along the river side of their private bollard fence. This rock placement was not included in their maintenance plan and will effectively prevent the "fully established vegetative cover" they claim will provide fully effective erosion protection. The rock placement will also initially exacerbate redirection of erosion and scour impacts on National Butterfly Center lands by creating a temporary hard point that redirects flow energy.

The haphazard and unprofessional approach to long-term maintenance demonstrated in Fisher Industries' maintenance plan and their non-engineered rock placement demonstrates a complete lack of understanding of professional standards for safe and effective construction and maintenance of infrastructure in large dynamic floodways like the Rio Grande.

5. *Fisher Industries most recent hydraulic model is flawed, and even if it conformed to professional engineering standards for the development of useful hydraulic models, is not capable of assessing the impacts of the private bollard fence on adjacent areas, including National Butterfly Center lands.*

I reviewed and ran the HEC-RAS hydraulic model provided by Fisher Industries. The organization, naming conventions, and general model documentation is characterized by numerous typographical errors and inconsistencies that demonstrate a level of carelessness in model development that I am not accustomed to in professional practice.

The technical details of the model similarly indicate a lack of familiarity with professional standards for hydraulic evaluation of river infrastructure. The most problematic technical components of the Fisher

Industries hydraulic model include representation of the bollard fence, development of roughness inputs, treatment of boundary conditions, and calibration. Neither the model, nor readily available model documentation support the use of this hydraulic model to support assertions that the private bollard fence will not negatively impact adjacent areas, including National Butterfly Center lands.

Bollard fence representation: The Fisher Industries model represents the fence as a change in the ground topography with large, regularly spaced openings rather than the continuous structure with small openings that has been constructed. This results in hydraulic simulations that are unrealistic. While this may be appropriate to evaluate large scale changes in water depths as required by the IBWC, it is entirely inappropriate to evaluate local scale changes in flow velocities and shear stresses, as well as the resulting changes in sediment transport and impacts of redirected erosion and scour. The model also considers a maximum blockage of only 30%. A professional engineering analysis of long term performance of the fence and its impacts on adjacent areas must assume complete blockage.

Roughness: Roughness is used in a hydraulic model to represent resistance to flow from different surfaces such as an open channel or a vegetated channel bank. The Fisher Industries hydraulic model uses extremely high roughness values, roughness values that are different from the values assumed in their model calibration, and a hydraulically smooth roughness value in the cleared area along their private bollard fence that is not representative of conditions that will occur when vegetation is fully established as Fisher describes in their maintenance plan.

Boundary Conditions: Boundary conditions in a hydraulic model control how flow enters and exits the model domain. Appropriate treatment and sensitivity testing of boundary conditions is essential to achieve realistic simulations of hydraulic conditions. Fisher Industries' hydraulic model uses a downstream boundary condition that is downstream of the available topographic data. It also uses a normal depth calculation assuming a slope that is at least an order of magnitude greater than the actual slope of the Rio Grande immediately upstream. In addition, the Fisher Industries' model does not use a "break line" in HEC-RAS along Anzalduas Dam Road, which means that the model does not "see" the road as a continuous, high elevation linear feature. All of these issues call into question the validity of Fisher Industries' flawed hydraulic model.

Calibration: Fisher Industries calibration approach for their hydraulic model has numerous shortcomings. First, it relies on only one extrapolated elevation point. Reasonable calibration typically relies on multiple measured elevation points at multiple flows. The calibration also appears to rely on unrealistically high roughness values. Compounding these important calibration issues is a lack of clear and sufficient

documentation of the calibration approach and results. Documentation indicates that "Several calibration runs were conducted to match the WSE upstream of Anzalduas Dam extrapolated from the value measured at the gage 0.5 mile downstream of the dam," but no details are provided to explain these runs or how they support the calibration of the hydraulic model.

Even if Fisher Industries' hydraulic model met professional engineering standards in the areas described above, the limited interpretation of model results summarized in correspondence and documents intended to satisfy IBWC requirements is inadequate to determine the impacts of the fence to adjacent areas, including National Butterfly Center lands. The IBWC process focuses on two narrow criteria: 1) changes in water surface elevation caused by a structure, and 2) flow deflections caused by a structure. While the model documentation and correspondence from the IBWC indicate that Fisher Industries' hydraulic model shows the fence causes changes in both of these criteria, the IBWC does not appear to conclude that these changes are significant enough to prohibit construction of the fence. The IBWC process does not evaluate the long-term performance of the fence or the long-term geomorphic evolution of the Rio Grande floodway that will be caused by the fence and result in damages to adjacent areas, including National Butterfly Center lands.

Further Affiant sayeth not.

Signature,

SWORN TO AND SUBSCRIBED before me by Mark Robert tompkins on this the 28th day of Aug., 2020.

(SEAL)

Notary Public - State of California

ESPERANZA BEATRIZ CRUZ
Notary Public - California
Alameda County
Commission # 2239728
My Comm. Expires Apr 26, 2022

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California, County of Alameda

Subscribed and sworn to (or affirmed) before me on this 28th day of August, 2020 by Mark Tompkins proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me.